The Structure of *Isis hippuris*, Linnæus.

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(Plate 43.)

The genus *Isis* was established by Linnæus in 1737 in his 'Hortus Cliffortianus,' p. 479, but he did not then include under the generic appellation the species to which it was afterwards applied. These he referred to the genus *Sertularia*. In his 'Systema Naturæ,' ed. x. 1758, p. 1287, Linnæus rearranged his species, and placed in the genus *Isis* not only the species referred to, but also all the Isidinæ, "le Corail" as well as the Encrinites. Pallas, in his 'Elenchus Zoophytorum,' 1766, accepted the classification of Linnæus and gave the following generic description:—"Colony arborescent, sedentary; axis calcareous, porous with longitudinal striations, or jointed, bearing a fleshy cortex; verrucæ sparsely scattered; polyps flower-shaped, oviparous, with a crown of tentacles, retractile." Under this category he placed the following species:—*I. nobilis*, *I. dichotoma*, *I. ochracea*, and *I. hippuris*. In 1786, Ellis & Solander, in 'The Natural History of many curious and uncommon Zoophytes,' p. 105, defined the genus in the following terms:—"An animal growing in the form of a plant whose stem is stony and jointed; the joints are furrowed longitudinally and united together in some by a spongy, in others by a horny substance. It is covered over by a soft porous and cellular flesh, full of little mouths from whence the polyps with their claws come forth, through whom the eggs are produced." They also noted the relationship between this genus and the Gorgonids, a relationship based on the presence in both of "the axis, support or bone of the animal"; the only difference being the presence of joints in that of the genus under consideration, while in the latter the axis is horny throughout. They suggest that the "articulation" of the axis is an adaptation for swaying in the water, flexing backwards and forwards in the currents, and so minimising the possibilities of fracture. To these eminent naturalists we are also indebted for the first figures of any species of this genus, Tab. 3. figs. 1–5 representing various parts of *I. hippuris*, Linn. The only other species described by them are *I. ochracea* and *I. coccinea*. It is also to

Ellis and Solander that we are indebted for the introduction of the terms nodes and internodes; but it must be noted that these are used to describe the calcareous and horny parts respectively, whereas the converse usage is now adopted. The following is their description:—"Axis articulated, calcareous, sparsely branched; the calcareous portion is white, cylindrical and furrowed; the internodes are black, horny, constricted, and attached to the nodes." In 1791 Esper depicted the axis in three fine plates, and gave a good general description of external features. Lamarck, in 1801, placed this group between the Gorgonacea, with an axis apparently horny, and the "Corail," with an entirely calcareous skeleton. In a later work, published in 1816, he narrowed down the generic distinctions and established a new group, "les Mélitées" (Genus *Melitæa*). Following this, Lamouroux in the same year established yet another division under the name of "les Mopsés" (Genus *Mopsea*): and at the same time united the three under "l'ordre des Isidées," *i. e.*, "tous les Coralliaires dont l'axe est articulé." This innovation was not accepted by Blainville in 1834 (XVI.), but was adopted by Ehrenberg 1834 (XVII.), Lamarck 1836 (XII.), Dana 1846 (XIX.), and Milne-Edwards & Haime in subsequent works (XX., XXI., & XXII.).

The classification would thus appear as follows:—

Isidinæ with an axis which bears internodes
- (*a*) horny in appearance. Branches borne on
  - (1) the calcareous nodes = *Isis*.
  - (2) the horny internodes = *Mopsea*.
- (*b*) of a suberous appearance..... = *Melitæa*.

Lamarck's 'Hist. Nat. des Anim. sans vertèb.' 2nd ed. 1836, vol. ii. p. 473, thus defines the genus:—"Colony attached, tree-like, composed of a jointed axis surrounded by a cortex not cohering but deciduous. Axis central, erect, branched, formed of calcareous striated *nodes* and horny constricted *internodes*. The cortex bears polyps in the fresh state, but is totally or partially deciduous when taken from the water." The writer discusses the question of relationship, and from the presence of horny internodes suggests affinity with *Gorgonia* and *Antipathes*, in which, he remarks, the axis is not calcareous but entirely horny. Brief notes on the following species are also given:—*I. hippuris*, Linn., *I. elongata* (Esper), *I. dichotoma* (Linn.), *I. encrinula* (Lamk.), *I. coralloides* (Lamk.), *I. gracilis* (Lamk.), *I. erythracea* (Lamk.), and *I. melitensis* (Lamk.).

Dana, in his 'Zoophytes,' 1846 (XIX.), thus limits the genus :—"Isinæ consisting of corneous and calcareous joints alternately; branches proceeding from the calcareous joints; cortex thick, deciduous."

In 1857 Milne-Edwards & Haime (XXII.) recapitulate the genus in the following terms :—"Colony with axis alternately calcareous and horny; calcareous portions sclerobasic, varying n length according to the specimen and having horizontally disposed ridges straight or bent; branches borne on the calcareous portion." At the same time they refer briefly to two new species established by Steenstrup, viz. *I. polyacantha* and *I. moniliformis*, as well as to the older species *I. coralloides* (Lamk.) and *I. elongata* (Esper).

It will be seen that, up to this point, no account has been taken of the spiculation; but in the 'Proceedings of the Zoological Society,' 1857, Gray gives the following important though indefinite amendment :—"Bark thick, with a few interspersed very irregular and unequal spicula." His remarks on two other points of structure are also very relevant and cannot be overlooked :—(1) that the bark is permanent and hard, but is brittle and easily removed, especially if the specimens be kept in a dry place: hence Lamarck's "caduce en totalité" (2) sometimes the horny parts become obliterated by an excessive growth of the calcareous portion, and this may account for Lamarck establishing the genus *Cynosaire* (Mém. Mus. Hist. Nat.).

In the same work Gray also established the genus *Isidella*, into which he merged no fewer than four of Lamarck's species of *Isis*; and at a later date (1887) G. von Koch changed his *Isis neapolitana* to *Isidella neapolitana*. The following is Gray's diagnosis of *Isidella* :—"Coral branched, furcate. Axis smooth, cylindrical; stony joint elongate; branches furcate, proceeding from the corneous joint. Bark rather thick, with irregular opake spicula; polypiferous cells produced, subcylindrical; base of axis expanded, lobed and branched."

The genus under consideration has thus received its position from the nature of its axis, with but indefinite knowledge of cortex, polyps, and spicules; but in 1865 Kölliker, in his 'Icones Histiologicæ,' rendered this part of the work more precise by his introduction of a more definite spicular basis of classification. The following gives precisely his important addition :—"I know only the spicules of the cœnenchyma of *I. hippuris*, which

exhibit spindles beset with spiny warts, of which the simplest are in sixes, eights, or twelves. Some are simple clubs, and probably represent those of the cortical layer. The warts on one side are smaller than those on the other. Tetraradiate forms are not uncommon. The size of the largest spicule is 0·18 mm." The only other species referred by him to this genus are *I. moniliformis* (Steenstrup), *I. gracilis* (*Mopsea gracilis*), Lamouroux.

Studer in 1878 established a new species, *I. antarctica*; and G. von Koch, in 1887, referred to this genus another form under the name *I. neapolitana*.

Wright & Studer, in the 'Challenger' Report, vol. xxxi. 1889, tersely sum up the foregoing characters, and accept Kölliker's description of the spicules of *I. hippuris* as typical of the genus, placing it in the Family Isidæ, Subfamily Isidinæ. At the same time the genera *Primnoisis* and *Callisis* were added to the classification, and this necessitated the abolition of certain species formerly placed in the genus *Isis*.

Thus we see that since the genus was established by Linnæus in 1737 no fewer than nineteen species have been added by various authors, but, strange to say, only one now remains as an authentic species, viz. *I. hippuris* (Linnæus). The following table represents these species, the second column indicating their place under the present system of classification and nomenclature:—

Isis antarctica, Stud., 1878.	*Primnoisis antarctica*, W. & S., 1889.
I. aurantia, Esper, 1797.	*Melitæa aurantia*, Gray, 1857.
I. capensis, Stud., 1878.	*Primnoisis capensis*, W. & S., 1889.
I. coccinea, E. & S., 1786; Gmel.; Esper.	*Melitæa coccinea*, Gray, 1857.
I. coralloides, Lamk., 1836; M.-Edw. & H., 1857.	*Isidella* (?) *coralloides*, Gray, 1857.
I. dichotoma, Linn., 1737; Lamk., 1836.	*Mopsea dichotoma*, W. & S., 1889.
I. dichotoma, Pallas, 1760. *Mopsella dichotoma*, Gray, 1857.	*Melitodes dichotoma*, W. & S., 1889.
I. elongata, Esper, 1797; M.-Edw. & H., 1857; Lamk., 1836.	*Isidella elongata*, Gray, 1857.
I. encrinula, Lamk., 1836.	*Mopsea encrinula*, Gray, 1857.
I. erythræa, Lamk., 1836.	*Isidella elongata*, Gray, 1857.
I. flexibilis, Pourt., 1868.	*Callisis flexibilis*, W. & S., 1889.
I. gracilis, Lamk., 1836; Lamx.	*Isidella elongata*, Gray, 1857.
I. gregorii, Gray, 1868.	

hippuris, Linn., 1758; Pall., 1766; & S., 1786; M.-Edw. & H., 1857; Gray, 1857; Köll., 1865; W. & S., 1889.
. *melitensis*, Lamk., 1836.
I. moniliformis, Steenstrup; M.-Edw. & H., 1857.
I. neapolitana, von Koch, 1887.
I. nobilis, Pallas, 1766; Lamk., 1822.
I. ochracea, Linn., 1758; Pall., 1766; Esper, 1797; Gmel.; E. & S., 1786.
I. polyacantha, Steenstrup; M.-Edw. & H., 1857.

Isis hippuris, Linn., 1758.

[1887.
Isidella neapolitana, G. von Koch,
Corallium rubrum, Lam., 1801.
Melitæa ochracea, Gray, 1857.

I. gregorii, *I. melitensis*, *I. moniliformis*, and *I. polyacantha* are almost names without descriptions, and so cannot with certainty be referred to their proper place in classification.

Isis hippuris.

1608. *Hippuris saxea*, Clusius, I. p. 124.
Corallium album articulatum, Seba, t. iv. p. 202, pl. 110. fig. 1.
1737. *Sertularia ramosissima*, Linnæus, II. p. 480.
Isis hippuris, Linnæus, 1758, III. p. 799; Pallas, 1766, VI. p. 233; Ellis & Solander, 1786, VII. p. 105, pl. 3. fig. 1; Esper, 1797, VIII. tom. i. p. 279, pl. 1, pl. 2, pl. 3 A. figs. 1–5; Lamouroux, 1816, XIV. p. 475; Lamouroux, 1821, XV. p. 59, pl. 3. fig. 1; Lamarck, 1816, XI. tom. ii. p. 302; Blainville, 1834, XVI. p. 503, pl. 86. fig. 1; Lamarck, 1836, XII. p. 475; Steenstrup, XVIII.; Cuvier, Règne Anim. tom. iii. p. 312; Dana, 1846, XIX. p. 144; Milne-Edwards & Haime, 1857, XXII.; Gray, 1857, XXIII. p. 283; Kölliker, 1865, XXIV. p. 140, tab. 19. figs. 42 & 43, tab. 16. fig. 4; Wright & Studer, 1889, XXXII.

In 1766 Pallas, in his 'Elenchus Zoophytorum,' gives a brief summary description couched in the following terms:—"Axis articulated, alternately branched; cortex thick and slightly porous." Twenty years later Ellis & Solander, with their usual precision and careful observation of detail, describe some specimens obtained at Sunda and Sumatra. Their somewhat lengthy description (*i. e.*, in comparison with the usual terse and contracted diagnoses of the time) is well worth quoting:—"Jointed stony stem, which rises into many loose branches. The bone or support of the animal consists of white, cylindrical, stony, channelled joints connected together by black contracted horny intermediate ones. The flesh is whitish, plump and full of minute vessels; the surface of it is full of the little mouths of the cells which are disposed in a quincuncial order, covering the

polyps with eight claws. In length they vary from 5 inches to 1 or 2 feet or more. In some the stony joints are longer and the black horny joints very short; in others the black horny joints are longer but always more contracted. The coral spreads its base on rocks by various turnings and windings both of its bony and fleshy part, and likewise as it rises we find it enclosing shells and other extraneous substances, that stick to it, like the Gorgonias." To Ellis & Solander we are also indebted for the only figures of this species showing the cœnenchyma. These are reproduced by Esper and supplemented by fine figures of the skeleton.

In 1821 Lamouroux specifies it as follows:—"Branched, branches few in number; cortex thick; polyps not having protruding verrucæ; axis articulated, nodes calcareous, with irregular longitudinal striations, internodes horny."

The new edition of Lamarck, in 1836, practically adds nothing to the description, but emphasises Ellis & Solander's points thus:—"Cortex thick, non-prominent verrucæ, polyps with eight tentacles (claws)." Ten years later Dana referred to this species several specimens from the East Indies, but does not in any way give more precision to this little-known group.

The next and last reference to newly-collected and authentic specimens is made by Milne-Edwards & Haime, who, in 1857, thus defined the species from specimens collected at Amboina:—"Colony large and branched, branches elongated, almost straight; calcareous nodes subcylindrical, elongated, two or three times longer than broad, with sinuous striations; internodes very short and horny." In 1865, however, Kölliker, in revising the Alcyonaria in his 'Icones Histiologicæ,' makes reference to the spicules of this species. He says they consist of (1) spindles beset with spiny warts, of which there may be six, eight, or twelve on each; (2) simple clubs, probably representing the cortical layer, with the warts on one side longer than those on the other. The size of the largest spicule is 0·18 millim. In the 'Challenger' Report, vol. xxxi., Wright & Studer, having found no specimens of this species in the collection made during that voyage, to make their classification complete give the following diagnosis, which is the last systematic reference to the genus:—"Colonies branched, with thick cœnenchyma, within which the polyps can be wholly withdrawn. The spicules are radiately stellate and covered with rough warts, of which there may be six, eight, or twelve on each. Some simple club-like forms also occur."

From the foregoing considerations it is at once evident that this genus is not only so far imperfectly described but also insufficiently known to warrant its rank in a thoroughgoing modern classification. It is hoped that the following observations may give more precision and definiteness to a species, the sole representative of a distinct family.

In the Littoral collection made by the Royal Indian Survey Ship 'Investigator' in the Indian Ocean are a number of specimens which I have no hesitation in referring to this widely distributed species. Almost all are of a light brown colour, which in the dry condition appears as buff or ochreous-yellow. In some of the specimens which have been damaged and are apparently decayed the cœnenchyma is almost white.

As the colonies under examination present certain differences *inter se*, and at the same time do not altogether conform to the figures given by Ellis & Solander and reproduced by Lamouroux, it will be useful to make a few general notes on the more typical specimens, before discussing in detail the features of more diagnostic importance. The following measurements were taken of the height, breadth, and thickness, in centimetres :—

I. 9·5×8×3·5. II. 9×6×4. III. 7×6×3. IV. 10·5×4×2. V. 6·5×7×4. VI. 5·5×4×4. VII. 6×4×3. VIII. 6×4×3.

In the largest and most complete specimen (Pl. 43. fig. 1) the branching is somewhat antler-like and is mostly confined to three planes, so that the great majority of the branches are directed towards one surface. The main stem is 8 millims. in diameter, and about 3 centims. from the base two large branches arise at slightly different levels. The sinuous nature of the branches is a marked feature in this colony, the branches themselves being separated by distances of about 5 millims. The secondaries and tertiaries are short, thick and cylindrical for the greater part of their length, but have characteristic steep conical terminations. One of the larger branches is devoid of cœnenchyma, and shows clearly the internodal origin of the subsidiary branches.

A second specimen, which is incomplete, consists of part of a main stem 6 centims. in length, from which several branches arise in all directions. Of these, however, only one, which is 9 centims. in length, bears the terminal twigs intact. The branches spring from the main stem at varying angles, about 45° being the most frequent. The large complete branch curves inwards toward the main stem and gives origin to several smaller

branches, some of which remain simple while others bear curved twigs.

The third of the specimens whose measurements are given (Pl. 43. fig. 2) may be regarded as the most typical, although it is evidently only the terminal portion of a large colony. It is very robust and bushy in appearance and maintains a marked upward growth. The main branch is 8 millims. in diameter, and gives origin to several almost equal branches of about 5 millims. in diameter. From these, secondary twigs diverge in all directions, but all have their growing tips pointing upward. The average diameter of these is about 3·5 millims. at their origin, but many terminate in club-shaped processes which increase this measurement to about 6 millims. Owing to excessive growth in the cœnenchyma, the angle between a twig and its support becomes almost obliterated; so that a branch presents a somewhat palmate appearance, with short blunt digitiform processes—the growing tips of the twigs (Pl. 43. fig. 2).

The next largest specimen is much damaged and may be the basal portion of a very large colony. The main stem, which is incomplete, is 7 centims. long and has a diameter of 9 millims. at the base, diminishing to 4 millims. at the broken tip. The branches which arise from it do not seem proportionate to the main stem, but there is evidence of the broken remains of larger branches now quite overgrown by the general cœnenchyma. The sinuous and cylindrical character of the branches is a marked feature.

The other four colonies whose measurements are given agree, on the whole, most closely with the third specimen.

Thus we see that the general tendency in this species is towards an upward bushy growth (Pl. 43. fig. 2), but in the largest and most complete specimen (Pl. 43. fig. 1) the twigs were directed mainly towards one aspect.

Another remarkable feature here presented is the fact that *there is no hint of attachment*. The basal portion is very thick and has evidently been broken from its support, but it is now completely overgrown by the cœnenchyma. This secondary growth is to be seen in the case of another branch in this specimen, and is not of infrequent occurrence in several of the others. May not this circumstance, to a great extent, explain the unilateral direction of the growing points of the branches in this specimen, as contrasted with the typical form in the others? Having become detached from its support, and with a

tendency to lie horizontally, the colony would produce branches towards the upwardly directed surface. It seems to me that this consideration is worthy of attention in reference to other plastic colonies whose contour is subject to great modification through position, the agency of currents, and the like. It leads one to recognize that the general shape of a colony affords but a slender basis on which to raise a superstructure of classification.

In this specimen also the development of club-shaped ends on the twigs is hardly noticeable; and as this feature is most predominant in the forms with developing eggs, it may be a nutritive phenomenon or a natural safeguard against premature rupture by the ever-increasing abnormally large embryos.

The axis (fig. 1) consists of white calcareous internodes and brown horny nodes. The internodes are symmetrically sculptured, ridges and furrows alternating around the whole circumference. The ridges appear smooth to the naked eye, but when slightly magnified present a beautifully serrated edge. They vary in number in the different parts of the colony, being comparatively fewer in the younger portions. Twelve, thirteen, and fourteen are common on the larger branches. In the older parts of the colony the internodes are almost cylindrical, but on the primary and secondary branches they are slightly narrower at the middle, while in the twigs they are torpedo-shaped. The nodes resemble fish-vertebræ in form. They are short and markedly constricted, and have a silky lustre. At the ends they are slightly ridged, conforming to the contour of the internodes; but this gradually diminishes, so that at the centre they are perfectly smooth. They contain no calcareous matter, except near the base, where a central limy rod connects them with the internodes. In mass they appear dark brown, but in section the colour is golden yellow.

The nodes and internodes vary in length throughout the colonies, so that no general size can be stated as typical. The following measurements of a node and its adjacent internode were taken at different parts:—

(*a*) Main stem:

Internode 4·5 millims. in length and 7 millims. in diameter.
Node 3 „ „ 6 „ „

(*b*) Branch:

Internode 6 millims. in length and 3 millims. in diameter.
Node „ „ „ 1·5 „ „

The branches arise from the calcareous internodes, generally one from each; but as many as three sometimes occur on one internode. In most cases there is a considerable calcareous portion before the first node; but this is often so reduced that the branches seem to arise with a horny part. In other places, owing to the origin being close to the node, the branch seems to arise from it.

Cross and longitudinal sections of a calcareous part, 1 centim. in diameter, were ground to show the internal structure. There is a distinct radiate appearance from centre to periphery. About 1·2 millims. from the centre there is an undulating line which corresponds to the grooves on the outside, but in this case they are fewer in number. Towards the circumference, and at a distance similar to the first, there is another almost identical line with a greater number of undulations, but still fewer than those on the periphery. These wavy lines doubtless correspond to what were previously the external surfaces of the axis. The central portion is quite homogeneous in character and is apparently amorphous; but in the younger part it is evidently composite, the small particles giving different extinctions. It cannot be argued from this, however, that the axis is sclerogorgic, because the boundary-lines of the different parts may be the organic remains of the dead calicoblasts. At the same time, it is important to note that in similar sections of *Melitodes* little or no difference could be found. This subject is worthy of further study, seeing that it is used as a basis of classification. When the internodes were decalcified, there was a considerable residue of organic matter.

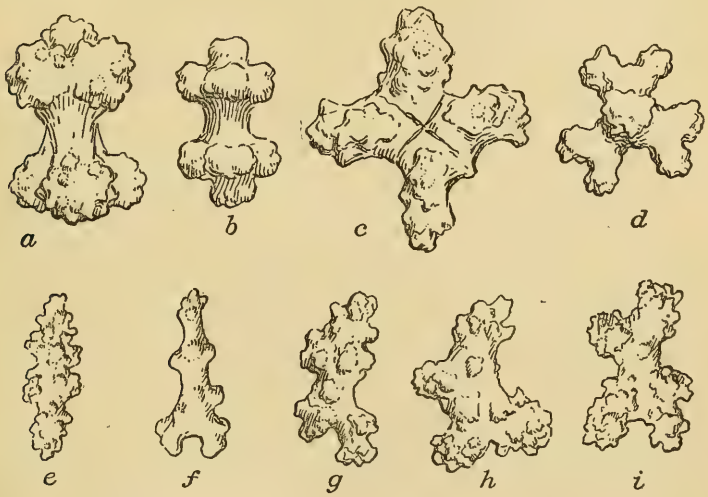
The cœnenchyma is very thick (Pl. 43. fig. 3), in some parts 2·5 millims. It is supported by small, densely-packed spicules of various shapes, which make it very brittle; and hence the markedly deciduous character, so often referred to. On the surface there is a layer of spicules arranged so that all their warty ends project outwards, and so form a specially hard protective layer. Owing to the enormous preponderance of spicules, it was almost impossible to cut sections. Decalcification resulted in a complete collapse of the cœnenchyma.

The nutritive system consists of (1) a longitudinally arranged set of canals, one corresponding to each groove on the axis; (2) a branching system throughout the cœnenchyma connecting these with the individual polyps. These canals have soft flaccid

walls, are circular in section, and have a diameter in some cases of about 1 millim.

The polyps (Pl. 43. fig. 4) are scattered over the whole cœnenchyma at intervals of 0·5 to 0·1 millim. There are no verrucæ; so that when the anthocodiæ are withdrawn the surface presents a dotted appearance. Round each of the openings the spicules are grouped in eight bundles, and so form a stellate figure. The expanded polyp has a length of 1·25 millim.

The tentacles are 0·5 millim. in length, with a diameter of 0·5 millim. at their base. They are flat and lanceolate, and bear a single row of short, thick, cylindrical pinnules. They are first infolded so as to form a somewhat elongated cone, and then the whole is withdrawn within the level of the cœnenchyma. The polyp-cavities (Pl. 43. fig. 3) are vase-shaped, and have a depth of 1·25 millim., with a maximum diameter of similar dimensions.



Spicules *a–i*: different types from the cœnenchyma.

It is interesting to note that we have here another example of viviparity among Alcyonaria. As Prof. Hickson notes ('Marine Investigations in South Africa,' vol. i. (1902) p. 84), the occurrence of embryos has been recorded in *Corallium rubrum* (Lacaze-Duthiers), some species of *Clavularia*, *Sympodium* (*Alcyonium*) *coralloides* (Marion and Kowalewsky) and in three

species of *Nephthya* (Koren and Danielssen). To these Hickson added *Gorgonia capensis*. As embryos have also been noted by Thomson and Henderson in *Chrysogorgia flexilis*, *Ceratoisis gracilis*, *Distichoptilum gracile*, *Pennatula indica*, *Umbellula elongata*, *Funiculina gracilis*, *Clavularia pregnans*, and *C. parvula*, it is evident that viviparity occurs in very diverse types of Alcyonarians.

In some of the specimens under consideration embryos of enormous size are present. These are situated either singly or in pairs, though in some cases three are to be found. They have a diameter of about 1 millim., and are apparently in an advanced stage of development. They are of the same colour as the general cœnenchyma and present a glistening appearance.

The spicules are very diverse in character. The following are some of the more prominent types, with measurements of length and breadth in millimetres:—

(*a*) Cœnenchyma.

(1) Rods with at each end a whorl of three large papillose warts: $0{\cdot}2 \times 0{\cdot}1$, $0{\cdot}2 \times 0{\cdot}15$.

(2) Tri- and quadri-radiate forms: $0{\cdot}1 \times 0{\cdot}1$, $0{\cdot}125 \times 0{\cdot}125$.

(3) Stellate forms with warty knobs: $0{\cdot}1 \times 0{\cdot}1$, $0{\cdot}075 \times 0{\cdot}075$.

(4) Short rods with large warty knobs irregularly arranged: $0{\cdot}2 \times 0{\cdot}125$, $0{\cdot}15 \times 0{\cdot}1$.

(5) Irregular and intermediate forms: $0{\cdot}2 \times 0{\cdot}1$, $0{\cdot}07 \times 0{\cdot}07$.

(*b*) Anthocodiæ. Similar forms, but slightly smaller.

(*c*) Tentacles. Stout rough clubs with short handles, warty at the end: $0{\cdot}055 \times 0{\cdot}045$, and 0·2 at the narrow smooth part.

Locality. Andaman Sea, 20 fathoms; also surf-line.

Previously recorded from:—Pacific Ocean (*Wright & Studer*); Indian Ocean (*Ellis*, *Pallas*). Mediterranean Sea (*Pallas*). America (*Pallas*). North Sea (*Linnæus*). Iceland (*Olafsen & Polvesen*, *Lamouroux*). Antilles and United States (*Lamouroux*). Straits of Sunda and Southern Coast of Sumatra (*Ellis*). East Indies (*Dana*). Amboina (*Milne-Edwards & Haime*).

In conclusion, I wish to express my indebtedness to Prof. Alcock, Indian Museum, Calcutta, for giving me an opportunity of studying this very interesting and unique Alcyonarian, and to Prof. J. Arthur Thomson for criticism and encouragement.

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EXPLANATION OF PLATE 43.

Fig. 1. Colony (without attachment) (nat. size), showing the unilateral method of branching; also a part of the axis devoid of cœnenchyma, showing the ridges and furrows; also the internodal origin of the branches.

2. Typical colony (nat. size), showing the palmate terminations of the twigs.

3. Tip of a branch (×10) with one half cut away, showing (i) the excessive thickness of the cœnenchyma; (ii) the longitudinal nutritive canals; (iii) the retracted polyps sunk in cavities in the cœnenchyma; (iv) the enormous embryos *in situ*; (v) the thick muscular bands.

4. Part of the surface of the cœnenchyma enlarged (×14), to show the polyps in different stages of retraction, with the small mound-like elevations.

Notes on some Species of *Nereis* in the District of the Thames Estuary. By H. C. Sorby, LL.D., F.R.S., F.L.S.

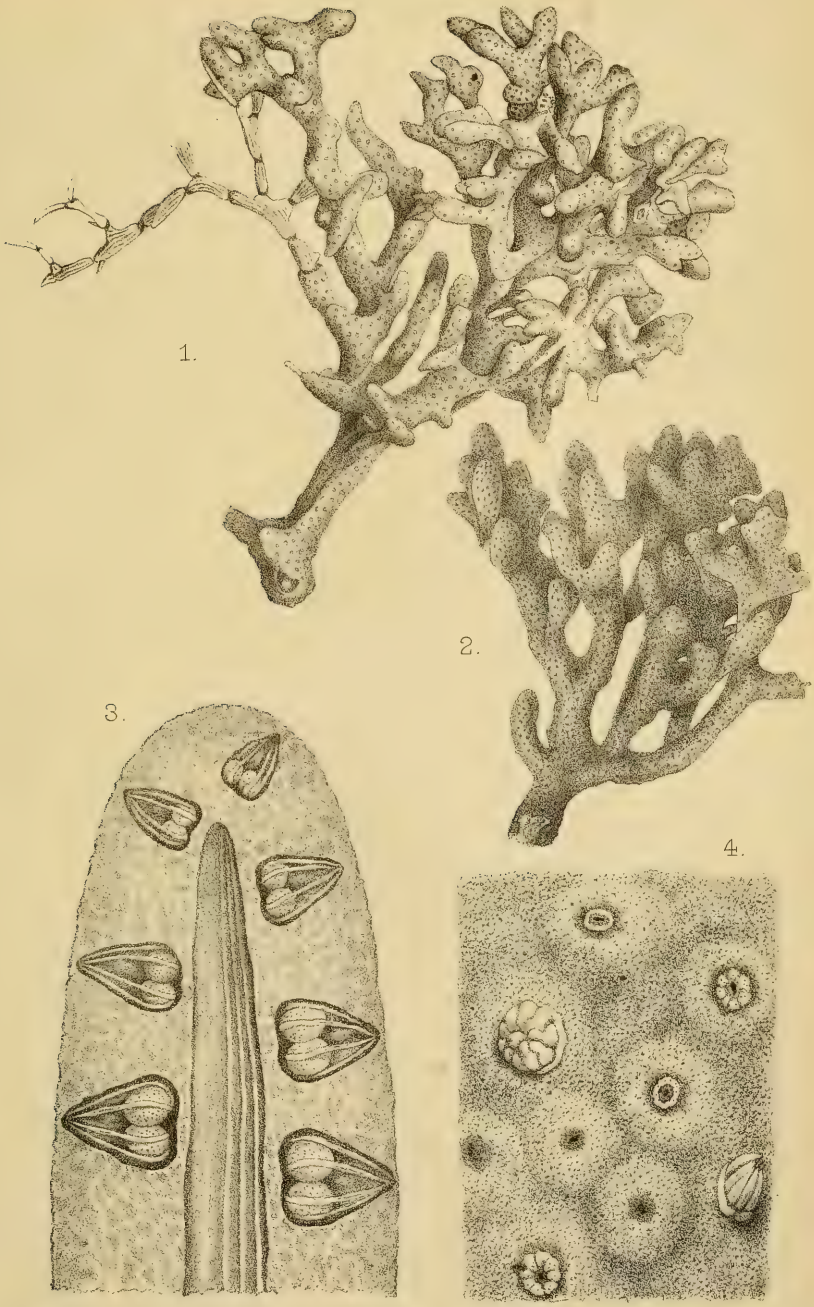
[Read 1st March, 1906.]

For more than 20 years I spent four or five months each summer (May to September) on board my yacht 'Glimpse' in various parts of Kent, Essex, and Suffolk, devoting myself much to the study of the marine animals. During this time I was able to observe a number of interesting remarkable facts connected with the *Heteronereis* form of two species of *Nereis*, which occur rarely.

Except in a few rare cases, when properly mounted in balsam, the natural colour is to a great extent preserved, and it is quite easy to see the form and colour of the jaws, even when completely retracted, and the form and colour of the prickles about the head, and of the eyes, as seen by transmitted light, and the ova, when present, which is not the case when specimens are preserved in alcohol or formalin.

The species found by me in the district of the Thames estuary are as follows:—

1. *Nereis diversicolor*, Müller.—Often very common in the mud of the estuaries left dry at low water, but rare in some of them.
2. *N. Dumerilii*, Audouin & Milne-Edwards.—Living in tubes formed amongst the marine plants. It must be numerous in some localities, but often lost when the plants are dredged up.
3. *N. longissima*, Johnston.—Very rarely found in the mud, but must be fairly common in some places.



A. R. Hammond lith. West, Newman imp.

ISIS HIPPURIS *LINN.*